Energy Management System with Agent-based Autonomous Reconfiguration

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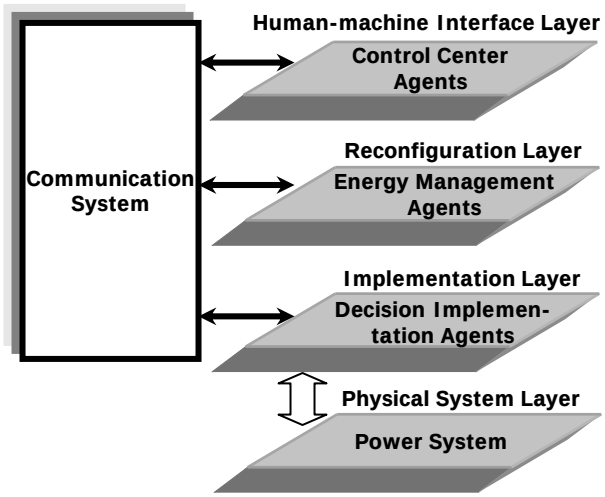
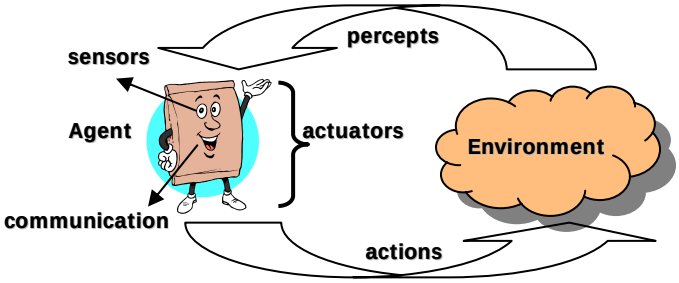
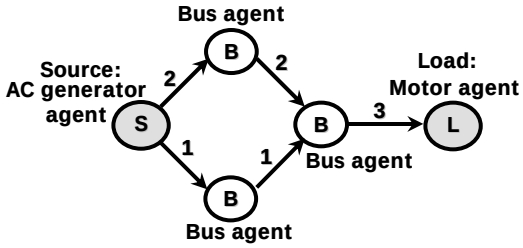
Research at West Virginia University's Advanced Power and Electricity Center (APERC) is investigating new concepts for autonomous energy management systems. The challenges faced by today's electric power system industry to provide secure and reliable power of high quality requires a new approach to deal with the competing demands. The formally regulated power industry is in the process of converting to an open access and market oriented system and is in need for decentralized solutions for both optimal performance at reasonable costs and improved survivability in case of disasters and disturbances caused by nature or humans. APERC is putting an agent-based system in place to create a robust network of problem solvers. Agents are responsible to autonomously act in place of human stake holders to achieve goals local to the agents themselves but also communicate to achieve global and system-wide objectives. For example, agents interact with humans and form a control center to make system operators aware of the current and possible future system performance. Another layer is responsible to provide suggestions on configuring the system optimally to satisfy the energy demand. Low-level tasks such as implementing decisions locally as made by higher-level agents are performed by another set of agents at the many devices connected within the electric power grid.



Overall architecture for the multi-agent energy management system. Agents act on behalf of humans within the layers and provide an autonomously acting system.



Each agent perceives its environment through sensors and acts on its environment through actuators. Together as a team the agents achieve system-wide objectives.



A simple example to show how agents work together to find a viable solution to the energy management problem: electric power is routed from the source to the load via buses of the eletric power grid.

Together as a team the agents build a flexible multi-agent system and implement a decentralized and autonomously acting decision-making system to aid in providing a new energy management concept. The advantages of this approach include graceful performance

degradation in case of failing components and/or agents and a more secure and reliable operation of the electric power system.

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